Voluntary Product Standard

PS 73-89

U.S. DEPARTMENT OF COMMERCE/National Institute of Standards and Technology

GLASS BOTTLES FOR CARBONATED SOFT DRINKS

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Voluntary Product Standard
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Glass Bottles for Carbonated Soft Drinks

Abstract

This Voluntary Product Standard covers conventional refillable and nonrefillable glass bottles that are manufactured from soda-lime-silica glass, that have a nominal capacity of not more than 36 fluid ounces, and that are intended for use in the packaging of soft drinks carbonated to a maximum of five volumes. Manufacturing requirements for bottles are provided for temper number, dimensional tolerances for height and maximum outside diameter, tolerances for capacity and mass (weight), perpendicularity, bottom characteristics and bottle identification, abrasion resistance, simulated impact resistance, wall thickness, detection of visual defects, internal pressure strength, and thermal shock resistance.

A model statement is included for use on manufacturing orders and invoices specifying the maximum carbonation volumes intended for the bottles. Terms are defined or described that include trade terms and methods for identifying bottles that conform to this standard.

Key words: Carbonated soft drink bottles; manufacturing requirements for glass bottles; refillable and nonrefillable soft drink bottles, Voluntary Product Standard for bottles.

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CONTENTS

Voluntary Product Standard PS 73-89
Supersedes PS 73-77

Glass Bottles for Carbonated Soft Drinks

Effective July 31, 1989 (See section 6.)

(This Standard, initiated by the Glass Packaging Institute, Inc., has been developed under the *Procedures for the Development of Voluntary Product Standards* of the U.S. Department of Commerce as a replacement of Voluntary Product Standard PS 73-77 *Carbonated Soft Drink Bottles*.)

1. PURPOSE

The purpose of this Voluntary Product Standard is to improve and maintain safety performance of glass bottles designed as containers for carbonated soft drinks by establishing nationally recognized manufacturing requirements. This Standard is intended to provide producers, distributors, users and other interested groups a basis for common understanding of the characteristics of these products and to specify inspection and test procedures to establish conformance to this Standard.

2. SCOPE

2.1 General—This Voluntary Product Standard covers conventional refillable and nonrefillable glass bottles that are manufactured from soda-lime-silica glass, that have a nominal capacity of not more than 36 fluid ounces,[1] and that are intended for use in the packaging of soft drinks carbonated to a maximum of five volumes. Manufacturing requirements for bottles are provided for temper number, dimensional tolerances for height and maximum outside diameter, tolerances for capacity and mass (weight), perpendicularity, bottom characteristics and bottle identification, abrasion resistance, impact resistance, wall thickness, detection of visual defects, internal pressure strength, and thermal shock resistance.

A model statement is included for use on manufacturing orders and invoices specifying the maximum carbonation volumes intended for the bottles. Terminology is presented that includes trade terms and methods for identifying bottles that conform to this Standard.

2.2 Head space—The bottles covered by this Standard shall be designed for the smallest head space (as determined by the fill point) consistent with the anticipated needs of liquid expansion and taking into account the capacity tolerances specified by bottle manufacturers and the filling tolerances specified by bottlers of soft drinks.

2.3 Application—This Standard applies only to so-called conventional glass containers that are manufactured according to requirements consistent with those described herein. It does not apply to other glass containers, such as those that are plastic-encapsulated, chemically tempered, or strengthened by other processes not currently used.

3. TERMINOLOGY

3.1 Bearing surface—the portion of the bottle base that contacts the supporting surface when the bottle is in an upright position. The contact area is near the outer circumference of the container. (See fig. 1.)

3.2 Bottles

3.2.1 Nonrefillable bottle—a bottle manufactured with mechanical-property characteristics that provide for its use as a single-service-trip container for carbonated soft drinks.

3.2.2 Prelabeled nonrefillable bottle—a nonrefillable bottle that has a label, applied during the manufacturing process, to cover at least the bottle's sidewall in order to prevent glass sidewall contact;

[1] This range of bottle capacities includes those in metric units up to 1 liter (33.82 fluid ounces).

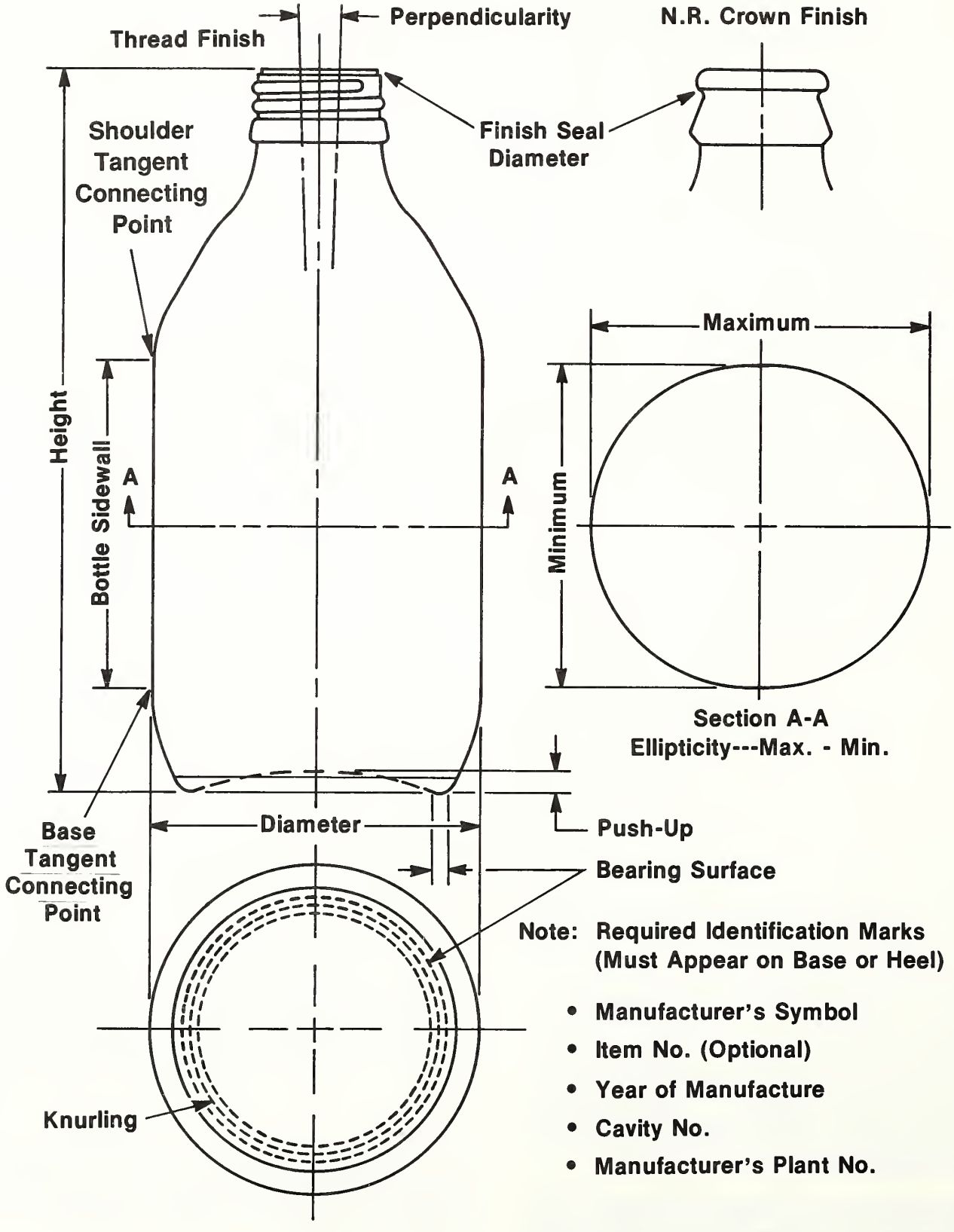

Figure 1. Soft drink bottle

that is, the sidewall area of the bottle shall be covered at least from the base tangent connecting points to the shoulder tangent connecting points. (See fig. 1.)

3.2.3 Refillable bottle—a bottle manufactured with mechanical characteristics that allow its use as a multiple-service-trip container for carbonated soft drinks.

3.3 Carbonation volume—the volume of carbon dioxide that is absorbed in the soft drink (or water) at a specific temperature and pressure and, thereby, has "carbonated" the soft drink. The following are for water:

3.3.1 One volume of carbon dioxide will be absorbed by an equivalent one volume of water at 60 °F (15.6 °C) and at one atmosphere or zero gage pressure.

3.3.2 Four volumes of carbon dioxide will be absorbed by one volume of water at 60 °F (15.6 °C) and at four atmospheres (about 44 psi or 300 kPa gage pressure).

3.3.3 Five volumes of carbon dioxide will be absorbed by one volume of water at 60 °F (15.6 °C) and at five atmospheres (about 59 psi or 400 kPa gage pressure).

3.4 Capacity (nominal)—the designed liquid content of a bottle as can be verified by filling the bottle to its designed fill point with water at 68 °F (20 °C).

3.5 Cavity number—the code that identifies each individual mold used in the production of bottles. (See fig. 1.)

3.6 Defects (visual)—the significant discontinuities or irregularities in the glass container that can be detected by visual inspection.

3.7 Head space (vacuity)—the volume of "empty" (gaseous) space for a bottle filled to its nominal capacity and is contained from the meniscus (or designed fill point) to the top of the bottle.

3.8 Heel—the lower section of the exterior bottle wall that begins at the lower tangent curve and ends at the base (bottom) of the bottle.

3.9 Fill point—the designed location of the meniscus (center) of the liquid product as measured from the top sealing surface, or from the base, of the bottle.

3.10 Finish

3.10.1 Standard crown finish—the upper portion of a bottle designed to accept a fluted crown closure. The skirt of the closure is crimped under the exterior glass locking ring of the bottle. (See fig. 1.)

3.10.2 Thread finish—the upper portion of a bottle designed to accept a closure over external threads. (See fig. 1.)

3.11 Inspection

3.11.1 Automatic inspection—a procedure by which bottles being produced are subjected to scanning by mechanical, optical, or electronic means or stress loading, in order to detect and then reject bottles with defects.

3.11.2 Visual inspection—a procedure used by manufacturers to detect and discard bottles with observable defects by utilizing properly trained personnel.

3.11.3 Qualified inspection and testing agency—an organization that has the following attributes:

(a) facilities and trained technical personnel to perform reliable testing;

(b) standard procedures that are followed by its personnel in evaluating bottle performance; and

(c) independent financially from any single company manufacturing the product, equipment, or any portion thereof being tested.

3.12 Knurling—a pattern of small projections on the bottom surface of the bottle. (See fig. 1, bearing surface.)

3.13 Lehr—the oven used for annealing the glass bottles.

3.14 Perpendicularity—the total horizontal displacement from the perpendicular of the top of the bottle when resting firmly on its base and then rotated 360° about the vertical axis. (See fig. 1.)

3.15 Reject—a bottle that is discarded after production.

3.16 "Round" of bottles—a group of bottles comprising one container from each cavity of the forming machine being used in production.

3.17 Soft drink—a carbonated, nonalcoholic, nonthermally processed beverage.

3.18 Minimum specification value—a value that for the purpose of process control defines the lower limit below which a re-sampling procedure shall be initiated.

3.19 Temper number—the designation of the relative annealing strain (residual stress) in a glass container that may be determined either by comparison with reference standards using a polariscope or by a method of measurement with a polarimeter for which the larger the number, the greater the associated strain. A *real* temper number is defined in terms of the *apparent* temper number, which is the measured value, and the bottom thickness of the container.

4. PERFORMANCE REQUIREMENTS AND INSPECTION AND TESTING PROCEDURES

4.1 General—This section sets forth general and specific performance requirements for soft drink bottles. It specifies for each important bottle characteristic both inspection and testing procedures that shall be used to determine the conformance of a bottle to this Standard. A producer that represents a product as conforming to this Standard shall keep for at least one year all records necessary to document the claim that the performance and inspection requirements of the Standard have been met. More detailed guidelines for carrying out these responsibilities may be provided for producers in the procedures recommended in ANSI standards Z34.1-1987 *Third Party Certification Program* and Z34.2-1987 *Self-Certification by Producers or Suppliers*.[2]

4.2 Temper number

4.2.1 Requirement—The bottles shall, after annealing, show no greater than real temper number 4 when examined under polarized light and compared to standard disks in accordance with the ASTM C 148-77 *Standard Methods for Polariscopic Examination of Glass Containers*.[3]

Note: The following relationship provides the real temper number of a bottle in terms of its measured apparent temper number and its bottom thickness:

$$T_R = T_A \frac{0.160}{t} \quad \text{(t in inches)}$$

or

$$T_R = T_A \frac{4.06}{t} \quad \text{(t in millimeters)}$$

Where T_R = real temper number
T_A = apparent temper number
t = bottom thickness (in inches or millimeters)

4.2.2 Inspection and testing procedures—At least one bottle shall be taken from each side and the center of an annealing lehr at least once every 2 hours during the manufacturing process and tested for temper number. If a bottle from a particular row does not meet the requirement of 4.2.1 for real temper number, then bottles from the adjacent row, or rows, shall be examined to identify and to bracket the rows of nonconforming bottles. The row, or rows, containing nonconforming bottles produced after a test failure shall be either re-annealed to conform to the requirement of 4.2.1 or rejected until the condition causing the failure has been corrected. Correction will be indicated when two bottles selected consecutively from the rejected row, or rows, shall meet the requirements specified in 4.2.1. If re-annealed, the same accept/reject criteria apply.

When a failure is detected for an annealing lehr, all pallets loaded with bottles produced from that annealing lehr since the last satisfactory test shall be detained. The bottles on the pallets in the identified nonconforming row, or rows, shall either be rejected or shall be qualified for acceptance by testing according to the requirement of 4.2.1. Two bottles selected in reverse order of production beginning with those last produced shall be tested until both bottles of the test pair indicate conformance.

[2] Copies of these publications are obtainable from the American National Standards Institute (ANSI), 1430 Broadway, New York, NY 10018.

[3] Later issues of this publication may be used providing the requirements are applicable and consistent with the issue designated. Copies of this publication are obtainable from the American Society for Testing and Materials (ASTM), 1916 Race Street, Philadelphia, Pennsylvania 19103.

The detained pallets of bottles shall be released after the bottles in the identified nonconforming row, or rows, have been re-annealed to conform to the requirement of 4.2.1; otherwise, they shall be rejected.

4.3 Dimensions and mass (weight)

4.3.1 Requirements—The bottles shall be designed to have an essentially round, cross-section. The producer and user of bottles shall agree upon the nominal height, maximum outside diameter, capacity, and mass (weight) of the bottle; however, the bottle shall be manufactured to meet the following applicable tolerance requirements:

(a) **Height**—The tolerance shall be within the limits specified in table 1. The bottle height shall be measured from the plane of the bottom to the plane of the top opening to the nearest 0.016 inch or 0.4 mm.

(b) **Maximum outside diameter**—The tolerance shall be within the limits specified in table 2. The maximum diameter of the bottle shall be measured to the nearest 0.016 inch or 0.4 mm. The ellipticity or "out of roundness" shall not exceed the values shown in table 2. (See ellipticity in fig. 1.)

Table 1. Height tolerance

Nominal height	Tolerance		Nominal height	Tolerance	
Inches	Refillable	Nonrefillable	*Millimeters*	Refillable	Nonrefillable
Less than 8	±0.030	±0.030	Less than 205	±0.8	±0.8
8 to <10	±0.045	±0.045	205 to <255	±1.2	±1.2
10 to <12	±0.080	±0.080	255 to <305	±2.0	±2.0
12 and >	±0.095	±0.095	305 and >	±2.4	±2.4

Table 2. Maximum outside diameter tolerance

Diameter range	Tolerance limit	Ellipticity	Diameter range	Tolerance limit	Ellipticity
Inches			*millimeters*		
Less than 2.375	+0.06 −0.03	0.060	Less than 60	+1.5 −1.0	1.5
2.375 to <2.750	+0.08 −0.06	0.080	60 < 70	+2.0 −1.5	2.1
2.750 to <3.625	±0.08	0.095	70 < 90	±2.0	2.4
3.625 to <4.125	±0.08	0.105	90 <105	±2.0	2.7
4.125 and >	±0.08	0.115	105 and >	±2.0	3.0

(c) **Capacity (nominal)**—The tolerance for capacity for both a refillable and nonrefillable bottle shall be within the limits specified in table 3 and shall be verifiable by filling the bottle to its designed fill point with water at 68 °F (20 °C). Capacity shall be measured to the nearest 0.03 fluid ounce or 1 mL.

Note: The nominal capacity does not include the space above the specified fill point which is referred to as "head space" (vacuity). The fill point and, hence, head space shall be agreed upon by the bottle producer and user; however, the head space should not be greater than 4% of the nominal capacity of any bottle designed after the effective date of this Standard. Upon request, the manufacturer shall make available to any interested party particular design specifications, including designed fill point and head space.

(d) **Mass (weight)**—The tolerance shall be within the limits specified in table 4. The mass shall be determined to within 0.016 ounce or 0.45 g.

(e) **Perpendicularity**—The perpendicularity of a bottle with a standard crown finish shall be less than 0.25 inch (6.4 mm). For a thread finish and threaded crown finish bottle, the perpendicularity shall be less than 0.19 inch (4.8 mm). The measurement shall be taken with respect to the external horizontal surface of the finish seal diameter. (See 3.14 and fig. 1.)

(f) **Bottom characteristics**

Push-up—The dimension of the bottom push-up of nonrefillable bottles shall be at least 0.06 inch (1.5 mm). For refillable bottles, the push-up shall be sufficient to insure that the bottle rests on the bearing surface only. (See fig. 1.)

Knurling—Knurling of the bearing surface shall be permitted on both refillable and nonrefillable bottles.

Table 3. Capacity tolerance[a]

Capacity[b]	Tolerance	Capacity[b]	Tolerance
fluid ounces		*liters*	
6 – 7	±0.16	0.18 – 0.20	±0.005
8 – 11	±0.16	0.24 – 0.32	±0.005
12 – 15	±0.20	0.36 – 0.44	±0.006
16 – 20	±0.28	0.48 – 0.59	±0.010
24 – 28	±0.32	0.71 – 0.83	±0.010
32 – 36	±0.36	0.94 – 1.06	±0.011

[a] The bottle size ranges include the metric capacities of .3 liter (10 fl. oz.), 0.5 liter (17 fl. oz.), and 1 liter (33.82 fl. oz.).

[b] The range of capacity indicated means from the lower value up to and including the larger value.

Table 4. Mass (weight) tolerance for refillable and nonrefillable bottles

Normal mass range	Tolerance	Normal mass range	Tolerance
avoirdupois ounces		*grams*	
Less than 6	±0.26	Less than 170	± 7
6 to < 9	±0.32	170 to <260	± 9
9 to <12	±0.38	260 to <340	±11
12 to <17	±0.50 −0.38	340 to <480	+14 −11
17 to <22	+0.64 −0.44	480 to <620	+18 −12
22 to <28	+0.76 −0.50	620 to <790	+21 −14
28 and >	+1.00 −0.64	790 and >	+28 −18

4.3.2 Inspection and test procedure—Each producer that represents products as conforming to the requirements of 4.3 shall utilize statistically-based sampling plans that are appropriate for these manufacturing processes. More sampling and testing requirements of bottles may be agreed upon between buyer and seller than those specified in this section.

4.4 Bottle identification marks—All bottles shall be marked legibly and permanently on the base or heel with the manufacturer's identification symbol, plant identification, cavity number, and year of manufacture. (See fig. 1.)

4.5 Abrasion resistance

4.5.1 Requirement (applicable only to nonrefillable bottles)—There shall be no seizing or audible grinding when surfaces of two wet bottles are rubbed together at an angle of approximately 45° under a 15-pound (67 N) load at a rate not to exceed 3 inches per minute (76 mm/min).

4.5.2 Inspection and testing procedures—A pair of bottles shall be taken from each side and the center of the annealing lehr at least once every 2 hours during production and tested for abrasion resistance. The bottles shall be immersed in water, two at a time, removed, and immediately tested. If there is seizing or an audible grinding during this test, all nonconforming bottles produced after the test either may be rejected or shall be re-coated until the condition has been corrected. Correction in production procedure will be indicated when bottles of a retest pair pass the abrasion resistance test.

After an initial failure has been verified, all pallets containing bottles produced from the annealing lehr since the last satisfactory test shall be detained. The detained bottles from the annealing lehr in question either may be rejected or shall be qualified for acceptance by testing, in sets of two, in reverse order of the production beginning with those last produced. The test procedures described shall be followed until a pair indicate conformance. All nonconforming bottles so tested will be either re-coated to conform to this requirement or rejected after which the conforming pallets shall be released.

4.5.3 Alternative method—A manufacturer may use surface-coating gaging devices that provide an equivalent level of process control as the abrasion resistance inspection and testing procedure of 4.5.2.

4.6 Simulated impact resistance

4.6.1 Requirements—Bottles shall withstand at least a 50-pound (220 N) force per vertical inch of bottle sidewall loaded when applied to the exterior of a bottle, including its full circumference.

4.6.2 Inspection and testing procedures—All bottles shall undergo a simulated impact by the application of at least a 50-pound (220 N) force per vertical inch of sidewall loaded. The bottles shall be subjected to this impact-resistance test around the full circumference in a suitable automatic device such as the squeeze-roll tester. Bottles that fail this test shatter and are thus removed from production.

4.7 Wall thickness

4.7.1 Requirements—The wall thickness of the bottles shall meet the minimum specification values given in table 5.

4.7.2 Inspection and testing procedures—A round of bottles shall be taken from the annealing lehr at least once every hour during production. The wall thickness of this round of bottles shall be measured to determine the thinnest section of the bottles. A suitable measuring device, such as an extension leg micrometer, shall be used for determining wall thickness; however, any automatic wall thickness gaging device may be used that provides the same level of process control.

If any bottle in the round fails to meet the minimum specification value for wall thickness, then four additional bottles produced from the represented cavity, or cavities, shall be tested. If a failure occurs among these four bottles tested, all bottles produced from the nonconforming cavity, or cavities, shall be rejected until the condition causing the failure has been corrected. Correction in the production procedure shall be accepted when the sidewall thickness of *all four* bottles of a tested lot exceeds the minimum specification value for wall thickness.

After an initial failure has been verified, all pallets loaded with bottles produced from the nonconforming cavity, or cavities, since the last satisfactory test shall be detained. These detained bottles shall be either rejected or qualified for acceptance by testing the bottles in groups of four in reverse order of production beginning with those bottles last produced until *all four* bottles of a test lot indicate conformance. Bottles that fail when tested shall be rejected; those that pass the test may be released.

Table 5. Minimum wall thickness specification

Outside diameter range	Minimum specification value	Outside diameter range	Minimum specification value
Refillable bottles (*inches*)		Refillable bottles (*millimeters*)	
Less than 2.41	0.060	Less than 61	1.5
2.41 to <2.76	0.070	61 to < 71	1.8
2.76 to <3.16	0.075	71 to < 81	1.9
3.16 to <3.76	0.080	81 to < 96	2.0
3.76 to <4.36	0.085	96 to <111	2.2
Nonrefillable bottles (*inches*)		Nonrefillable bottles (*millimeters*)	
Less than 2.69	0.045	Less than 69	1.1
2.69 to <3.01	0.055	69 to < 77	1.4
3.01 to <3.26	0.060	77 to < 84	1.5
3.26 to <3.64	0.065	84 to < 93	1.7
3.64 to <4.14	0.070	93 to <106	1.8
Prelabeled nonrefillable bottles (*inches*)		Prelabeled nonrefillable bottles (*millimeters*)	
Less than 2.69	0.030	Less than 69	0.8
2.69 to <3.01	0.035	69 to < 77	0.9
3.01 to <3.26	0.040	77 to < 84	1.0
3.26 to <3.64	0.045	84 to < 93	1.1
3.64 to <4.14	0.050	93 to <106	1.3

4.8 Visual defects

4.8.1 Requirements—Bottles shall be free of the following visual defects:

(a) **check finish**—appearance of shallow fractures confined to one surface of the glass container.

(b) **choked neck**—an imperfection consisting of an insufficient opening in the finish and neck of a bottle.

(c) **split finish**—a crack from surface to surface extending from top of the finish downward.

(d) **birdswings**—a string or strand of glass extending across the inside of the bottle.

(e) **blisters**—bubbles or gaseous inclusions of 0.125 inch (3.2 mm) or larger in size.

(f) **butterfly bruise**—a surface crack caused by a severe blow in which the fracture is usually curved in shape extending into the glass from the outside surface.

(g) **chipped finish**—an imperfection due to loss of a small fragment of glass out of an otherwise regular surface.

(h) **cracks**—fractures extending into or completely through the glass from either surface.

(i) **crizzle finish**—a multitude of fine surface fractures causing a frosty appearance on the sealing surface which could prevent an adequate seal.

(j) **down finish**—a sagging or irregular surface which could prevent an adequate seal.

(k) **off-set seams finish**—a sealing surface or finish threads misaligned to such an extent that proper seal or removal torque cannot be maintained.

(l) **overpress finish**—a glass fin projecting upward from the inside surface such that it may be broken or chipped in normal use.

(m) **stones**—unmelted batch or foreign matter embedded in the glass having a diameter of 0.062 inch (1.6 mm) or larger.

(n) **stuck glass**—extraneous glass fragments adhering to any surface of the bottle.

4.8.2 Inspection and testing procedures—The producer of soft drink bottles shall use only automatic inspection devices on a continuous basis to detect visual defects (a) through (c) listed in 4.8.1. For the

other defects listed, continuous visual inspections shall be carried out using either automatic devices or trained personnel.

4.9 Internal pressure strength

4.9.1 Requirements—Refillable bottles shall withstand a minimum internal pressure of 225 psi (1550 kPa). Nonrefillable bottles including prelabeled bottles shall withstand a minimum internal pressure of 200 psi (1380 kPa).

4.9.2 Inspection and testing procedures—A round of bottles shall be taken at least once every 2 hours from the annealing lehr during manufacture and tested for internal pressure strength using one of the following methods:

(a) **The 1-minute sustained pressure test**—At each level, pressure is sustained within the bottles for 1 minute starting at 150 psi (1030 kPa) up to and including 200 psi (1380 kPa) in increments of 12.5 psi (85 kPa) and at higher pressure levels in increments of 25 psi (170 kPa) in accordance with Method A of ASTM C 147-86, *Internal Pressure Test on Glass Containers*.[4]

(b) **The increment pressure test**—At each level, pressure is applied for 3 seconds starting at 150 psi (1030 kPa) over the same range as specified in 4.9.2(a) in accordance with Method A of ASTM C 147-86, *Internal Pressure Test on Glass*.[4] Because of the pressure gage response, the actual applied pressure will be 1.23 times the levels specified in the 1-minute sustained pressure test in 4.9.2(a). For example, at the levels of 225 and 200 psi (1550 and 1380 kPa), the actual applied pressures in the bottles would be 278 and 247 psi (1920 and 1700 kPa), respectively.

(c) **The continuously increasing test (the ramp test)**—The applied pressure is increased at a constant rate of 60 psi (410 kPa) per second starting at zero pressure and ending at a 1-minute equivalent pressure level that satisfies the requirements of 4.9.1 or as specified in Method B of ASTM C 147-86, *Internal Pressure Test on Glass Containers*.[4] The actual pressure level in the bottle is given by the following equation:

$$P_R = 1.38\ P_{60} + 25.9$$

where P_R is the actual pressure level in the bottle, and P_{60} is the 1-minute equivalent pressure level as indicated by the ramp pressure testing machine.

Note: Both the increment pressure tester and the ramp tester may provide a readout in 1-minute equivalent pressure values.

If any bottle in the round of bottles fails to meet the internal pressure test, then four additional bottles produced from the represented cavity, or cavities, shall be tested. If a failure occurs among these four bottles tested, all bottles being produced from the nonconforming cavity, or cavities, shall be rejected until the condition causing the failure has been corrected. Correction in the production procedure shall be accepted when all four bottles of a succeeding tested lot pass the minimum internal pressure requirements.

After an initial failure has been verified, all pallets loaded with bottles produced from the nonconforming cavity, or cavities, since the last satisfactory test shall be detained. The bottles from the nonconforming cavity, or cavities, either may be rejected or shall be qualified for acceptance by testing in groups of four in reverse order of production beginning with those last produced. Then the test procedure previously described shall be followed until all four bottles of the test lot indicate conformance. All bottles from any test lot that did not indicate conformance when so tested shall be rejected. After the nonconforming bottles have been removed, the detained pallets shall then be released.

4.9.3 Alternative testing—A producer may use an automatic off-line pressure testing procedure that satisfies the requirements of 4.9.1 and that provides results equivalent to those specified in 4.9.2(c) as certified by a qualified inspection and testing agency.

4.10 Thermal shock resistance

4.10.1 Requirement—Refillable bottles shall withstand a hot to cold thermal shock having a temperature difference of 75 °F (42 °C). This requirement may be achieved by transferring bottles from a hot water bath of 145 ± 2 °F (63 ± 1 °C) into a cold water bath of 70 ± 2 °F (21 ± 1 °C) within 15 seconds (± 1 second) in accordance with ASTM C 149-86 *Standard Method of Thermal Shock Test on Glass Containers*.[5]

4.10.2 Inspection and testing procedures—A round of bottles shall be taken from the annealing lehr at least once every 4 hours during production and tested for thermal shock resistance.

[4] See footnote 3.

[5] See footnote 3.

If any bottle in the round of bottles fails the thermal shock test, then four additional bottles produced from the represented cavity, or cavities, shall be tested. If a failure occurs among these four bottles tested, all bottles being produced from the nonconforming cavity, or cavities, shall be rejected until the condition causing the failure has been corrected. Correction in the production procedure shall be accepted when all four bottles of a tested lot pass the thermal shock test.

After an initial failure has been verified, all pallets loaded with bottles produced from the nonconforming cavity, or cavities, since the last satisfactory test shall be detained. The detained bottles from the nonconforming cavity, or cavities, either may be rejected or shall be qualified for acceptance by testing in groups of four in reverse order of production beginning with those last produced. Then the test procedure described above shall be followed until all four bottles of the test lot indicate conformance.

All bottles from any test lot that did not indicate conformance when so tested shall be rejected. After the nonconforming bottles have been removed, the detained pallet shall be released.

5. INTENDED USE

Intended use statement—Each manufacturing order and invoice for bottles shall contain a statement that specifies the intended use of the bottles in each shipment. The following statement is an example that may be used:

> "Bottles with a capacity of up to and including 36 fluid ounces, which also applies to bottles with metric capacity of 1 liter, are intended for use in the packaging of soft drinks carbonated to a maximum of 5 volumes."

6. EFFECTIVE DATE AND IDENTIFICATION

The effective date of this Standard is July 31, 1989. As of that date, reference to this Standard may be made in contracts, codes, advertising, invoices, product labels, and the like; however, a product shall not be advertised or represented in any manner that would in any way imply approval or endorsement of that product by the National Institute of Standards and Technology and/or the Department of Commerce.

The following suggested statements may be used in representing products as conforming to the requirements of this Standard:

> "This _____ conforms to all requirements established in Voluntary Product Standard PS 73-89, *Glass Bottles for Carbonated Soft Drinks*, developed and published in accordance with the U.S. Department of Commerce *Procedures for the Development of Voluntary Product Standards*. Full responsibility for the conformance of this product to the Standard is assumed by (name and address of producer and/or distributor)."

> "Conforms to PS 73-89, (name and address of producer and/or distributor)."

7. HISTORY

This publication is intended to supersede Voluntary Product Standard PS 73-77 *Carbonated Soft Drink Bottles*.

In 1976 Voluntary Product Standard PS 73-77 *Carbonated Soft Drink Bottles* was approved for publication by National Institute of Standards and Technology (NIST), formerly the National Bureau of Standards (NBS). The Standard was developed and published in response to requests received by NIST in January 1972 from the Glass Packaging Institute (GPI) and the National Soft Drink Association (NSDA) to develop a Voluntary Product Standard for bottles used by the carbonated soft drink industry. The Standard remained in effect until the current Standard PS 73-89 replaced it.

Current Edition

On August 23, 1983 the Standing Committee for PS 73-77 passed a motion to revise PS 73-77 to incorporate those major glass packaging items that were being used as soft drink containers (such as "plastishield" bottles which were being used at that time). The motion was adopted by a vote of 5-1. It was agreed that the GPI, the sponsor for PS 73-77, and the NSDA, representing bottlers of soft drinks, would jointly support the development of a draft.

The subsequent draft, designated TS233 and dated May 1984, did not meet with approval for numerous reasons. At the Standing Committee meeting in June 1984, recommendations were made that more extensive changes and additions should be developed to include the requirements for prelabeled refillable bottles and head space.

Other drafts that were completed in June 1984 and April 1985 did not receive the approval of the Standing Committee. In February 1987 NIST established an Ad Hoc Task Group to discuss the major unresolved issue of head space. That Task Group had representatives of the GPI and NSDA, consumers, bottlers, and manufacturers of bottles. The Task Group met in March 1987 and made a recommendation on that subject which was subsequently reviewed and approved by the Standing Committee by correspondence. The text of the Standard covering head space reflects that recommendation. Later, extensive editorial revisions of the draft standard were made by the secretariat at the NIST. The proposed standard was approved by the Standing Committee in May 1988.

The proposed Voluntary Product Standard TS233 dated August 1988 was distributed for public acceptance in September 1988. Responses indicated consensus among producers, distributors, and consumers in accordance with the published procedures. The Standard was approved for publication by the National Institute of Standards and Technology as Voluntary Product Standard PS 73-89, "Glass Bottles for Carbonated Soft Drinks," to be effective July 31, 1989.

8. STANDING COMMITTEE

A Standing Committee has been appointed to assist in keeping this Standard up to date. The names of the members of the Committee are available from the Office of Standards Management, National Institute of Standards and Technology, Gaithersburg, Maryland 20899, which serves as the secretariat for the Committee.

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Voluntary Product Standards—Developed under procedures published by the Department of Commerce in Part 10, Title 15, of the Code of Federal Regulations. The standards establish nationally recognized requirements for products, and provide all concerned interests with a basis for common understanding of the characteristics of the products. NIST administers this program as a supplement to the activities of the private sector standardizing organizations.

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